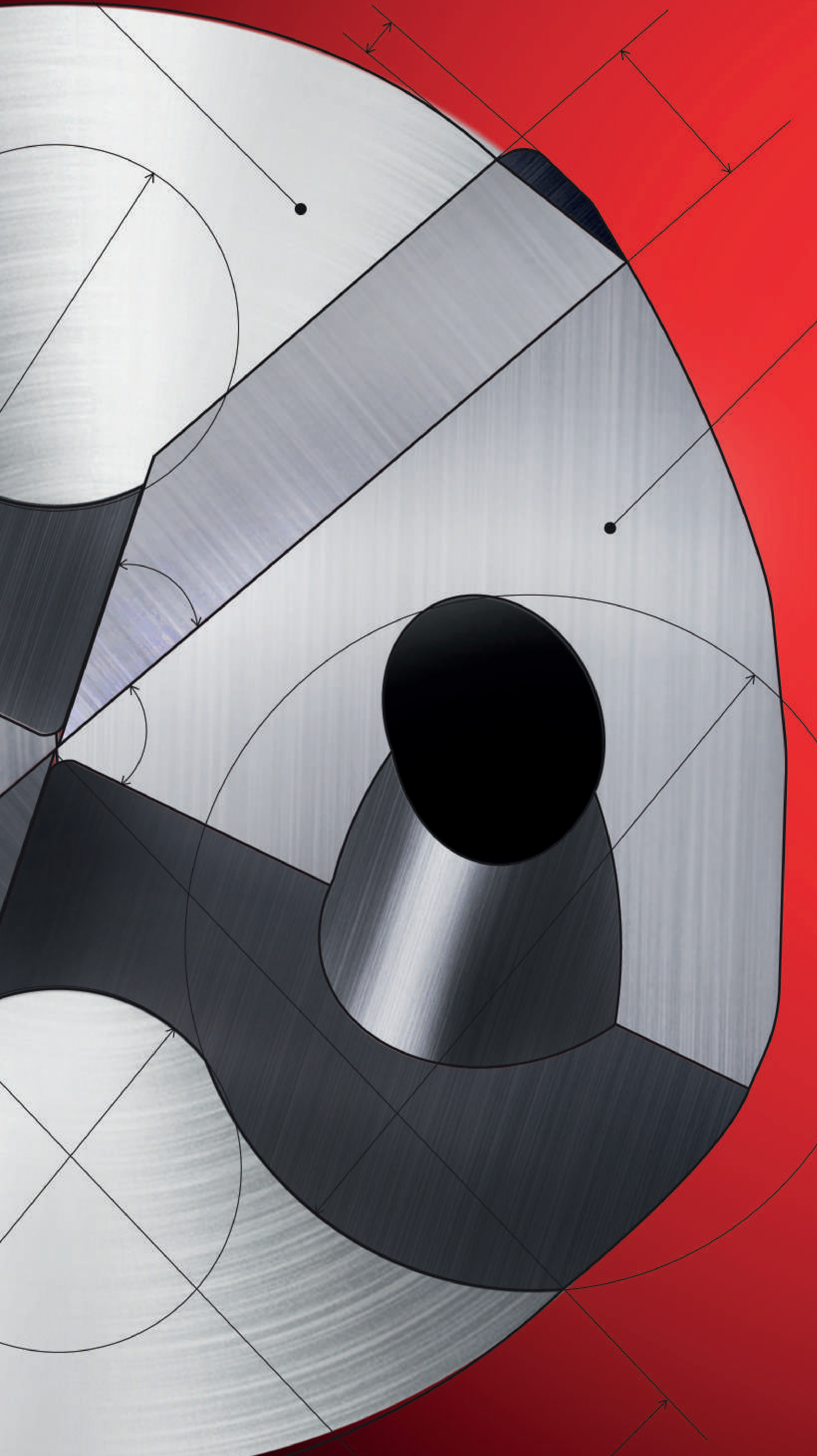


DRILL LINE

APPLICATION INDICATIONS AND SOLUTIONS FOR MILLING

Material	Ø up to 6 mm	Ø up to 10 mm	Ø up to 16 mm	Ø up to 25 mm	Ø over 25 mm
Steels up to 700 N/mm²	0,1 - 0,2	0,2	0,2 - 0,3	0,3 - 0,4	0,4
Steels 700 - 1000 N/mm²	0,1 - 0,2	0,2	0,2	0,3	0,3 - 0,4
Cast steel	0,1 - 0,2	0,2	0,2	0,2 - 0,3	0,3 - 0,4
Cast iron GG	0,1 - 0,2	0,2	0,2 - 0,3	0,3 - 0,4	0,3 - 0,4
Cast iron GGG	0,1 - 0,2	0,2	0,3	0,3 - 0,4	0,4
Copper	0,1 - 0,2	0,2 - 0,3	0,3 - 0,4	0,4	0,4 - 0,5
Brass - Bronze	0,1 - 0,2	0,2	0,2 - 0,3	0,3	0,3 - 0,4
Light alloys	0,1 - 0,2	0,2 - 0,3	0,3 - 0,4	0,4	0,4 - 0,5
Plastics, hard	0,1 - 0,2	0,2	0,4	0,4 - 0,5	0,5
Plastics, soft	0,1 - 0,2	0,2	0,2	0,3	0,3 - 0,4

Stock allowance (recommended values in mm)
Due to the efficient action of the spiral, the values for quick spiral reamers may be increased by 50 to 100%.

CENTERING AND PILOT DRILLING WITH HARD METAL AND HIGH-SPEED STEEL

Solid Carbide
When applying solid carbide drills for drilling depths 8xD to 12xD we recommend centring or the production of a pilot hole with a depth of 1xD to 2xD. With drilling depths larger than 12xD a pilot hole with a depth of 1xD to 2xD is imperative.

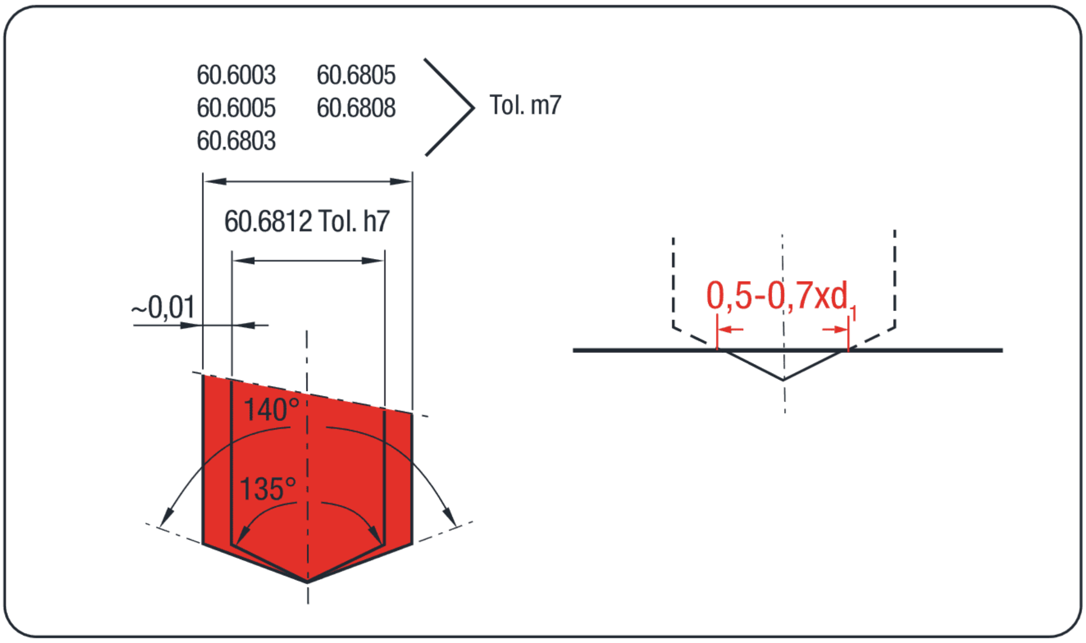
High Speed Steel
Centering with drill lengths to DIN 340

When using long series drills (DIN340) in HSS/HSCO, we recommend spot drilling with a spotting diameter of 0.5 to 0.7xD (D = drill diameter). HSS NC spotting drills are optimally suited for this process. Detailed information regarding NC spotting drills can be found in the NC spot drilling section.

Pilot drilling with drill lengths to DIN 1869

When applying extra length HSS/HSCO drills to DIN 1869 we recommend the production of a pilot hole with a depth of 1xD to 2xD.

Stub drills DIN 1897 are optimally suited.

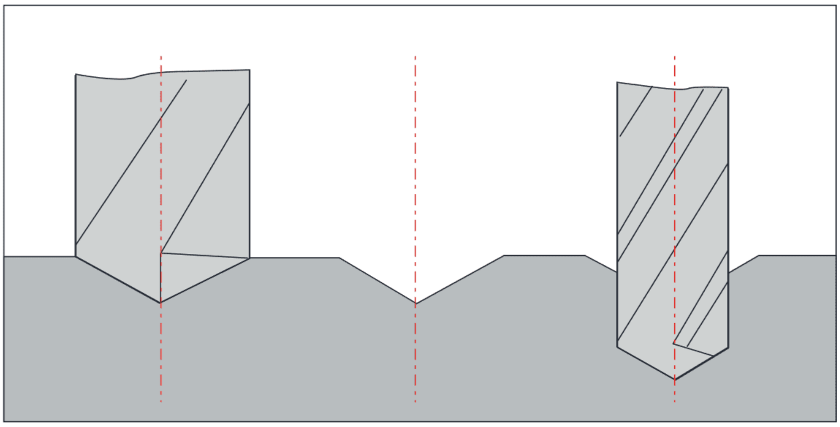


NC SPOTTING DRILLS

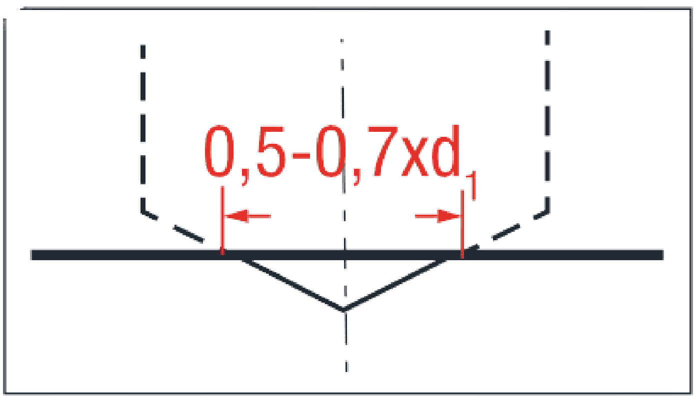
When producing accurately positioned holes, holes with close diameter tolerances, deep holes or generally with unfavourably shaped workpieces (round, rough. etc.) it's recommended to use a NC spotting drill. This ensures the following drill, drills accurately and prevents the drill from running off.

NC spotting drills can also be used to produce chamfers or countersinks (when using a spot drill with a larger diameter than the actual hole) and centring in one operation.

NC spotting drills are designed with a very short flute length and without body clearance to ensure a very rigid design and therefore accurately positioned spotting. Due to the design, NC spot drills are only suitable for spotting, drilling depths must not exceed the length of the point geometry.



SELECTING AN NC SPOTTING DRILL

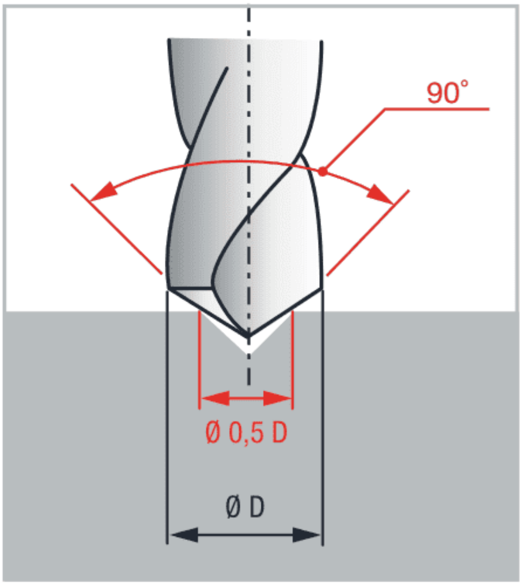


Ideally, the spotting diameter should be chosen between 0.5 to 0.7xD.

90º NC SPOTTING DRILLS

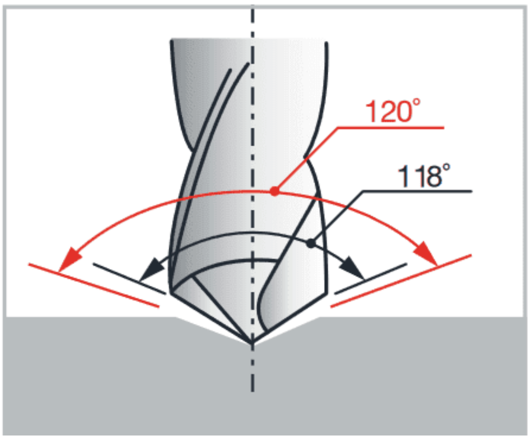
NC spotting drills with a 90º point angle are ideally suited for spotting if the following HSS/ HSCO drills have a relatively large diameter edge. This ensures that the following HSS/ HSCO drill drills with the cutting flute first and is guided by the most stable points of the cutting edge.

In addition, NC spotting drills with a 90º point angle are used to produce a 90º countersink and centre in one operation if the spotting diameter is larger than the actual hole diameter.



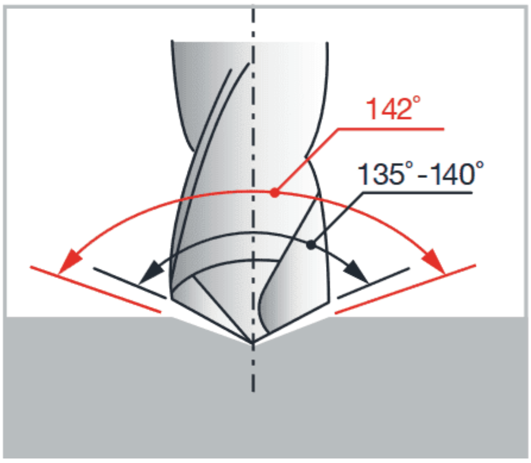
120º NC-SPOTTING DRILLS

NC-spotting drills with a 120º point angle are specially suited for spotting operations if the actual hole is subsequently produced with HSS/HSCO drills with a 118º point angle. This ensures the following HSS/HSCO drill spots with the point first and is well guided.

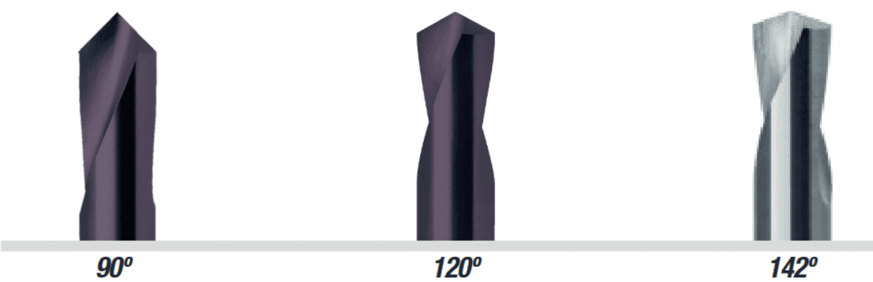


142º NC-SPOTTING DRILLS

NC-spotting drills with 142º point angle are specially suited for spotting operations if the actual hole is subsequently produced with carbide drills with a 135º - 140º point angle. This ensures the following carbide drill spots with the point first, centers and is well guided. If the cutting corners of the carbide drill meet the material to be machined before the point, there is the risk of corner crumbling with carbide drills.



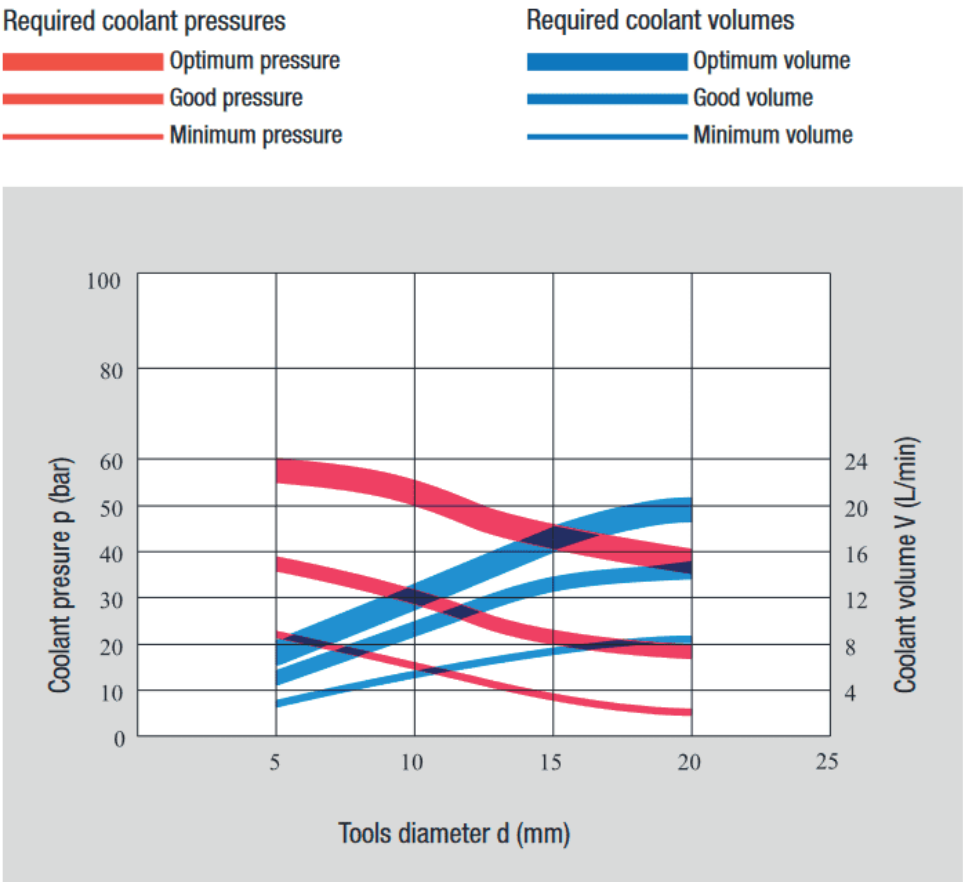
NC SPOTTING DRILLS



COOLANT PRESSURES AND VOLUMES - 60.68 BITS

The illustrated optimum, good and minimum required coolant volume apply only to spiral-fluted Series drills 60.68. In contrast to the pressure, which is a feature of the machine tool; the cooling system fitted to it and also the possibility of leakage, volume does not depend on the machine (fig. 1). The pressure figures given are therefore recommendations which serve only as guidelines.

The diagrams shown are for drills in their most important application, machining of steel. But they are also guidelines for the machining of other materials, primarily because the highest coolant pressures are constantly required for the machining of steel.



Required coolant pressures and volumes for drills with internal spiral coolant ducts.

DRILL HOLE SURFACE QUALITY

The overall total of the maximum positive and negative deviations is the sum of the total run-out in relation to the black circle as measured on standard instruments (dRmax). The red lines at the hole centres indicate the direction and amplitude of the displacements AV (Axis Shifting) of the produced hole from the true centre point. The parameter showing the largest deviation is decisive for the IT quality class of the hole in relation to the tool diameter.

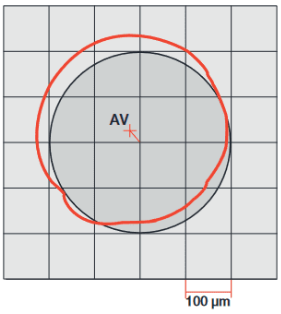
The black circle in the diagram represents the nominal hole diameter which the tool should ideally produce. The red circle indicates the form actually produced. The mean value of the radius of the red circle, i.e. the average diameter, is shown by the blue circle. (with our 60.6003 drills the average diameter is practically identical to the actual diameter produced).

1. in 42CrMo4V, Ø 14.5 mm

HSSCo U-NEWDRILL Drills
Broca HSSCo U-NEWDRILL
Ref. 11.1360

vc	= 25 m/min
f	= 0,25 mm/r
+Rmax	= 131,8 µm
-Rmax	= -49,1 µm
D-real	= 14,566 mm
dRmax	= 103,5 µm
AV	= 49,2µm

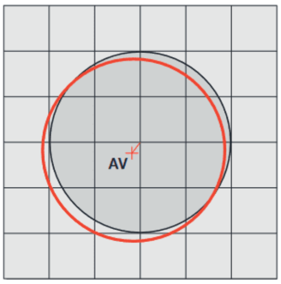
Ra = 2,6 µm, Rz = 6,8µm **IT12**



HM Drills 3XD DRILLANT
Broca MD 3XD DRILLANT
Ref. 60.6003

vc	= 70 m/min
f	= 0,25 mm/r
+Rmax	= 26,7 µm
-Rmax	= -17,2 µm
D-real	= 14,509 mm
dRmax	= 5,2 µm
AV	= 22,8 µm

Ra = 1,04 µm, Rz = 3,2 µm **IT18**

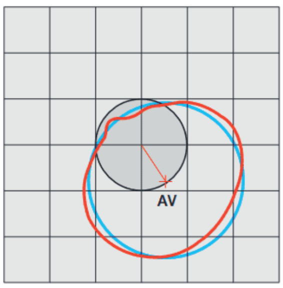


2. in GGG40, Ø 10,0 mm

HSSCo U-NEWDRILL Drills
Broca HSSCo U-NEWDRILL
Ref. 11.1360

vc	= 40 m/min
f	= 0,25 mm/r
D-real	= 10,077 mm
+Rmax	= 106 µm
-Rmax	= -28µm
dRmax	= 42 µm
AV	= 68,5 µm

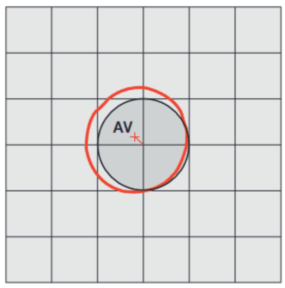
Ra = 3,7 µm, Rz = 17,2 µm **IT12**



HM Drills 3XD DRILLANT
Broca MD 3XD DRILLANT
Ref. 60.6003

vc	= 100 m/min
f	= 0,4 mm/r
D-real	= 10,027 mm
+Rmax	= 34 µm
-Rmax	= -9,2 µm
dRmax	= 6,5 µm
AV	= 22,5 µm

Ra = 2,2 µm, Rz = 11,5 µm **IT18**



TOLERANCES TO BE USED IN COMMONLY USED FITS

Diameter range (mm)		Tolerance zone class of shaft (µm)															
>	≤	E9	F6	F7	F8	G5	G6	H5	H6	H7	H8	H9	JS5	JS6	JS7	K5	K6
-	3	-14 - 39	- 6 - 12	−6 −16	−6 −20	−2 −6	−2 −8	0 −4	0 −6	0 −10	0 −14	0 −25	±2	±3	±5	+4 0	+6 0
3	6	- 20 - 50	- 10 - 18	−10 −22	−10 −28	−4 −9	−4 −12	0 −5	0 −8	0 −12	0 −18	0 −30	±2.5	±4	±6	+6 +1	+9 +1
6	10	- 25 - 61	−13 −22	−13 −28	−13 −35	−5 −11	−5 −14	0 −6	0 −9	0 −15	0 −22	0 −36	±3	±4.5	±7	+7 +1	+10 +1
10	14	- 32 - 75	−16 −27	−16 −34	−16 −43	−6 −14	−6 −17	0 −8	0 −11	0 −18	0 −27	0 −43	±4	±5.5	±9	+9 +1	+12 +1
14	18																
18	24	- 40 - 92	- 20 - 33	−20 −41	−20 −53	−7 −16	−7 −20	0 −9	0 −13	0 −21	0 −33	0 −52	±4.5	±6.5	±10	+11 +2	+15 +2
24	30																
30	40	- 50 - 112	- 25 - 41	−25 −50	−25 −64	−9 −20	−9 −25	0 −11	0 −16	0 −25	0 −39	0 −62	±5.5	±8	±12	+13 +2	+18 +2
40	50																
50	65	- 60 - 134	- 30 - 49	−30 −60	−30 −76	−10 −23	−10 −29	0 −13	0 −19	0 −30	0 −46	0 −74	±6.5	±9.5	±15	+15 +2	+21 +2
65	80																
80	100	- 72 - 159	- 36 - 58	−36 −71	−36 −90	−12 −27	−12 −34	0 −15	0 −22	0 −35	0 −54	0 −87	±7.5	±11	±17	+18 +3	+25 +3
100	120																

Diameter range (mm)		Tolerance zone class of shaft (μm)																
>	≤	E7	E8	E9	F6	F7	F8	G6	G7	H6	H7	H8	H9	H10	JS6	JS7	K6	K7
-	3	+24 +14	+28 +14	+39 +14	+12 +6	+16 +6	+20 +6	+8 +2	+12 +2	+6 0	+10 0	+14 0	+25 0	+40 0	±3	±5	0 −6	0 −10
3	6	+32 +20	+38 +20	+50 +20	+18 +10	+22 +10	+28 +10	+12 +4	+16 +4	+8 0	+12 0	+18 0	+30 0	+48 0	±4	±6	+2 −6	+3 −9
6	10	+40 +25	+47 +25	+61 +25	+22 +13	+28 +13	+35 +13	+14 +5	+20 +5	+9 0	+15 0	+22 0	+36 0	+58 0	±4.5	±7	+2 −7	+5 −10
10	14	+50 +32	+59 +32	+75 +32	+27 +16	+34 +16	+43 +16	+17 +6	+24 +6	+11 0	+18 0	+27 0	+43 0	+70 0	±5.5	±9	+2 −9	+6 −12
14	18																	
18	24	+61 +40	+73 +40	+92 +40	+33 +20	+41 +20	+53 +20	+20 +7	+28 +7	+13 0	+21 0	+33 0	+52 0	+84 0	±6.5	±10	+2 −11	+6 −15
24	30																	
30	40	+75 +50	+89 +50	+112 +50	+41 +25	+50 +25	+64 +25	+25 +9	+34 +9	+16 0	+25 0	+39 0	+62 0	+100 0	±8	±12	+3 −13	+7 −18
40	50																	
50	65	+90 +60	+106 +60	+134 +60	+49 +30	+60 +30	+76 +30	+29 +10	+40 +10	+19 0	+30 0	+46 0	+74 0	+120 0	±9.5	±15	+4 −15	+9 −21
65	80																	
80	100	+107 +72	+126 +72	+159 +72	+58 +36	+71 +36	+90 +36	+34 +12	+47 +12	+22 0	+35 0	+54 0	+87 0	+140 0	±11	±17	+4 −18	+10 −25
100	120																	

In every step given in the table, the value on the upper side shows the upper deviation and the value on the lower side, the lower deviation.

APPLICATION INDICATIONS AND SOLUTIONS FOR DRILLING

Problem	Cause	Solution
Borehole is too large	• Feed rate is too high • Chipping blockage • Run-out defect on the drill used • Grinds incorrectly	• Reduce feed rate • Use the correct tool • Reduce run-out defect as much as possible • Check grinding is correct
Burr at borehole exit	• Cutting speed is too fast • Wear limit width exceeded	• Reduce feed rate • Replace or re-sharpen tools in good time
Breakage of the cutting edge	• Unstable working conditions • Incorrect core hole drill • Unstable workpiece clamping • Wear limit width exceeded • Feed rate is too high • Flute clearance angle too great	• Clear spindle clearance • Use the correct core hole drill • Check workpiece clamping • Replace or re-sharpen tools in good time • Reduce feed rate • Carry out better re-sharpening
Fissure in the core	• Impact on the chisel edge • Drill tip too sharp • Feed rate is too high • Flute clearance angle too great	• Correct cutting speed • Re-sharpen correctly • Reduce feed rate • Re-sharpen correctly
Chisel edge wear	• Cutting speed is too low • Insufficient lubricating coolant delivery • Incorrect lubricating coolant composition • Feed rate is too high	• Correct cutting speed • Ensure good lubricating coolant delivery • Ensure good lubricating coolant composition • Reduce feed rate
Built-up edge development	• Insufficient lubricating coolant delivery • Incorrect lubricating coolant composition • Cutting speed is too low • Uncoated tool	• Ensure good lubricating coolant delivery • Ensure good lubricating coolant composition • Increase cutting speed • Use a coated tool
Poor borehole surface quality	• Feed rate is too low • Inaccurate positioning	• Increase feed rate • Centre borehole in advance
Vibrations	• Cutting speed is too high • Feed rate is too low • Unstable workpiece clamping • Run-out error of the core hole drill is too great	• Reduce cutting speed • Increase feed rate • Ensure stable workpiece clamping • Reduce run-out error
Flank wear	• Cutting speed is too high • Feed rate is too low • Clearance angle too small	• Reduce cutting speed • Increase feed rate • Increase clearance angle

Corner wear	• Excessive speed	• Reduce speed to the optimum • Possible increase in feed rate
Margin wear	• Cutting speed is too high • Run-out error of the core hole drill is too great • Tool tapering is insufficient • Insufficient lubricating coolant delivery • Incorrect lubricating coolant composition	• Reduce cutting speed • Reduce run-out error • Use tools that are more tapered • Ensure good lubricating coolant delivery • Ensure good lubricating coolant composition
Fluting edge breakage	• Poor chip removal • Drill bit is not stable in the chuck	• Remove earlier • Ensure that the drill bit is in the chuc
Stand length is insufficient	• Incorrect cutting specifications • Unstable workpiece clamping • Insufficient lubricating coolant delivery • Incorrect lubricating coolant composition	• Ensure cutting specifications are correct • Ensure stable workpiece clamping • Ensure good lubricating coolant delivery • Ensure good lubricating coolant composition

Here, you can find a few general tips for using the tools. Every day, we are asked different questions about problems in using them. To make your life a little easier, we have compiled potential problems, causes and solutions for the appropriate tool area.

There's always an answer or reason for why a drill, thread cutter, milling cutter or reamer does not work as required. The key is to know exactly where to go to resolve the problem.

We have summarized a few general examples of problems, their causes and their solutions to enable you to recognize your issue and the cause immediately, and the steps needed to choose the correct solution.